

Space Weather Technical Forecast

Issued on Wednesday, 05 January 2022 at 00:12 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: Slight chance of G1/Minor geomagnetic storms day 4 (8th)**Analysis of Space Weather Activity over past 24 hours**

Solar Activity: Solar activity was Very Low over the past 24 hours, with only B-flares observed. There are two sunspot regions on the visible disc, AR2924 Cso/Beta in the far southeast and a new unnumbered Cso/Beta region near the southeast limb, however this analysis is low confidence due to its near limb location.

No Earth-directed CMEs have been observed in the available imagery.

Solar Wind / Geomagnetic Activity: Solar winds as observed by DSCOVR and ACE at L1 were initially elevated at around 520km/s then declined to near background 390-420 km/s. Density declined from just above average to below average levels. The interplanetary magnetic field strength, Bt, was generally weak throughout, below 7nT with the north-south component (Bz) ranging -5 nT to +4 nT and a general trend from negative to positive values. Phi angle has been mainly positive (away from the Sun). Geomagnetic activity has been mostly Quiet to Unsettled (Kp 1-3).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) remained at background levels. High energy electron flux (greater than 2MeV) has been background or moderate levels. Electron fluence was below the Active threshold, but with a gradual rising trend, with 3.5e7 integrated pfu recorded at 05/0000 UTC.

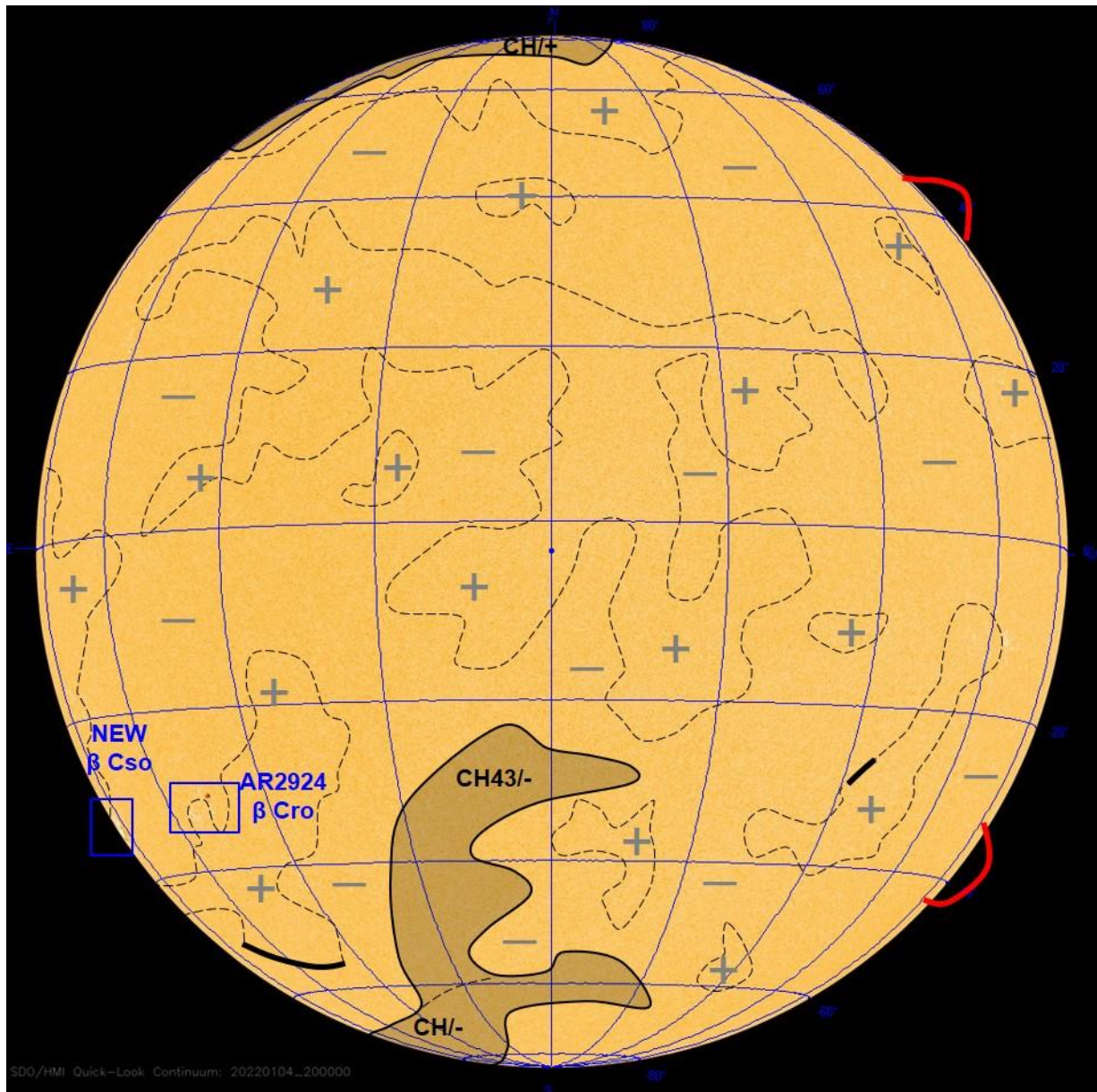
Four-Day Space Weather Forecast Summary

Solar Activity: Very Low solar activity is expected, with a chance of increasing to Low due to any C-flaring from either of the sunspots on the disc. Through day 3 and into day 4 (7th and 8th), the return of two old sunspots (ex2907, ex2908) from the previous rotation will potentially increase activity bringing a very slight chance of M-flares.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs. Solar winds are expected to be easing to background, and then persisting at this level until the arrival of any fast wind from coronal hole 43 occurs on day 4 (8th). Mainly Quiet geomagnetic activity is expected, increasing to Unsettled to Active with a slight chance of G1/Minor storm intervals on day 4 (8th).

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux is expected to remain at background levels. High energy electron flux (greater than 2MeV) is likely to exceed the High (1e3pfu) level at diurnal peak days 1 and 2 (5th and 6th), but otherwise generally moderate levels currently expected. Electron fluence is also likely to rise, potentially peaking day 2 (6th). While likely to remain below the Active level, there is a chance of rising above by the end of day 2 (5th).

Figure 1. Solar Analysis Valid 04/2000 UTC.



Key: Filament — , Prominence — , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

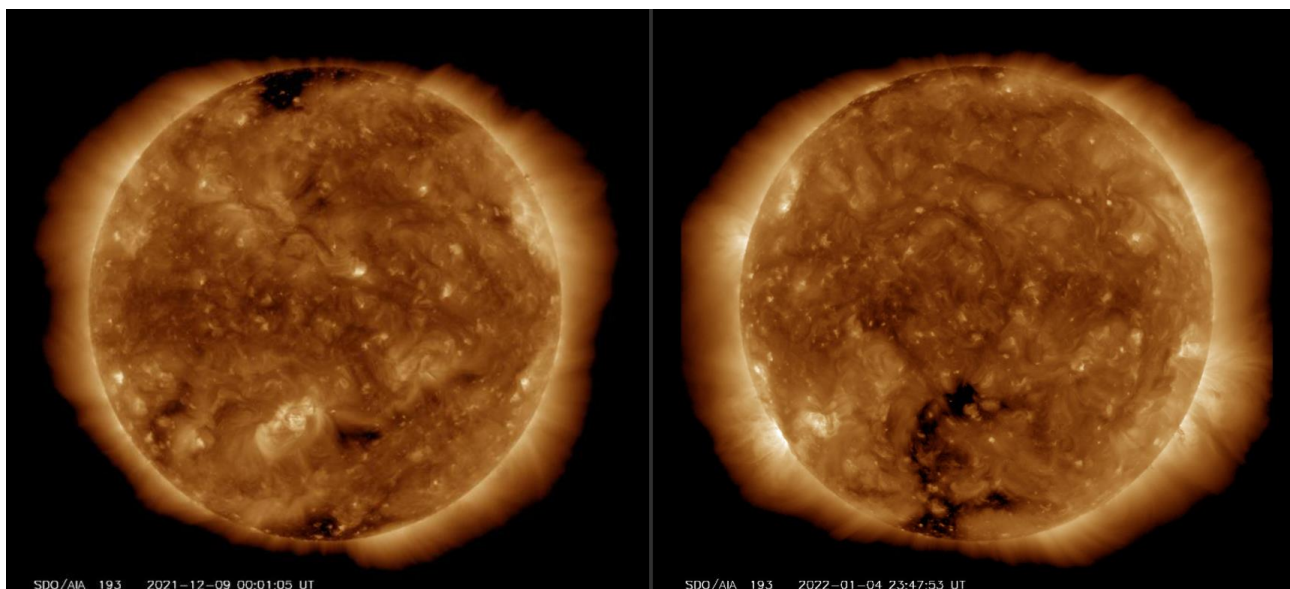
Geomagnetic Storms:

There no Earth-directed CMEs. Slightly elevated solar winds are expected to continue easing through day (5th), with mainly background winds persisting until the arrival of any fast wind of CH43, most likely day 4. This is a new feature on this rotation, so confidence is low on timing and strength, however elevated solar winds are possible (500-600km/s). This feature has yet to be observed at STEREO A, however this spacecraft is now only observing conditions around 2.7 days ahead of Earth.

Mainly Quiet geomagnetic activity is forecast until day 4, with Unsettled to Active and a slight chance of G1/Minor Storms with the arrival of any fast wind.

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	1	1	1	20
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: SDO aia-191 of previous (left) and current (right) rotation



Radio Blackouts - X-Ray Flares:

Solar Activity is currently Very Low. There are two sunspot containing active regions on the visible disc, however these are both small and simple.

AR2894 Cao/Beta is the only numbered sunspot, and has been slowly developing in the southeast quadrant through the last 24-36 hours. This is followed by an unnumbered region, which has only recently rotated onto the visible disc. Despite some notable looping visible on SDO aia-171 imagery and a strong signal on far-side products, this currently appears to be a small Cso/Beta region, situated within a region of strong plage. This was potentially ex-2906 on the previous rotation. A further strong region is also possible around the limb on day 4 (8th), as evident by its helioseismic signature. This corresponds to the region of ex2907 and ex2908 on the previous rotation, both of which produced M-flares on their previous transit across the Sun.

Very Low activity is expected to persist, with a chance of rising to Low from any C-flares from either of the two sunspots. This risk will increase day 3 (7th) onward, with a slightly increased chance of M-flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	2	2	5	5
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: GOES-16/17 X-ray Flux

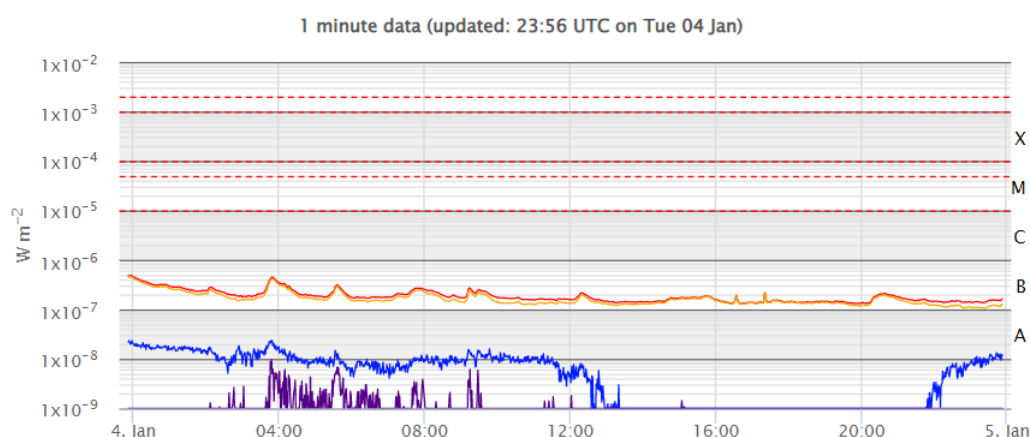


Figure 4: Helioseismic signal (from jsoc.stanford.edu)

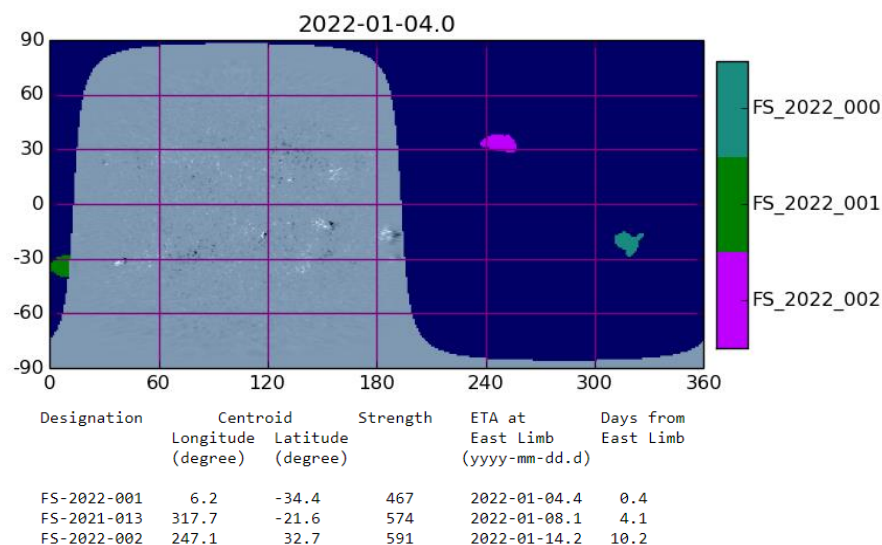
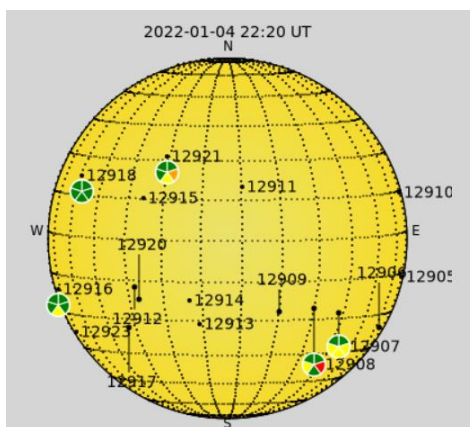


Figure 5: Raben Map of far-side spots, showing number of old active regions due to rotate back around.



Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as observed by GOES-16 is currently at background levels and will most likely persist at this level.

Radiation Storms	Level (cm ⁻² sr ⁻¹ s ⁻¹)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = cm⁻²sr⁻¹s⁻¹)

High Energy Electrons Event ($\geq 2\text{MeV}$):

The high energy electron flux (greater than 2MeV) as observed by GOES-16 is currently at predominately moderate levels, but expected to see peak values continue on a rising trend days 1 and potentially day 2, as solar winds continue to ease and allow the peak radiation belt flux to expand outward to GEO. This will bring a chance of High levels being observed at diurnal peak.

The associated 24 hour fluence is currently below the Active ($1\text{e}8$ integrated pfu) threshold, but with a gradual rising trend. Whilst likely remaining below the active level, there is a slight chance of it rising above by day 2 (6th). This is supported by REFM, which also has a rising trend, peaking just below Active on day 2 (5th).

GEO Electron Environment	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^8$	No	20	20	10	10
Very Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^9$	No	1	1	1	1

Figure 6: GOES-16 $>2\text{MeV}$ electron Flux and associated fluence with REFM

